REMARKS

Claims 1, 4, 5, 8, and 14-27 are all the claims presently pending in the application. Claims 9-13 have been canceled. Claims 1, 4, 8, 14, 16, and 19-21 have been amended to more particularly define the invention. Claims 22-27 have been added to claim additional features of the invention. No new matter has been entered.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicant specifically states that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

With respect to the claim objections, Applicant respectfully submits that claims 4, 8, 19, and 21 have been amended to alleviate the Examiner's concerns.

Claims 16-18 stand rejected under 35 U.S.C. § 102(b) as being allegedly anticipated by Harwig et al. ("Electrical Properties of β-Ga_2O_3 Single Crystals. II", Journal of Solid State Chemistry Vol. 23, pages 205-211, 15 January 1978).

Claims 1, 4, and 5 stand rejected under 35 U.S.C. § 103(a) as being allegedly unpatentable over Harwig in view of Ueda et al. ("Synthesis and Control of Conductivity of Ultraviolet Transmitting β-Ga_2O_3 Single Crystals", App. Phys. Lett. 70 (26), 30 June 1997). Claim 8 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Harwig in view of Ichinose et al. (U.S. Patent Publication No. 2004/0007708 A1). Claims 19-21 stand rejected under 35 U.S.C. § 103(a) as being allegedly unpatentable over Harwig.

The rejections mentioned above are respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

An exemplary aspect of the claimed invention (e.g. as recited in claims 1 and 16) is directed to a method of controlling a conductivity of a Ga_2O_3 system single crystal that includes adding a predetermined dopant to the Ga_2O_3 system single crystal such that said dopant is substituted for Ga in the Ga_2O_3 system single crystal to obtain a desired conductivity. The predetermined dopant includes a p-type dopant for controlling the conductivity of the Ga_2O_3 system single crystal, the p-type dopant comprising one of H, Li, Na, K, Rb, Cs, Fr, Be, Mg, Ca, Sr, Ba, Ra, Mn, Fe, Co, Ni, Pd, Cu, Ag, Au, Zn, Cd, Hg, Tl, and Pb, the conductivity of the Ga_2O_3 system single crystal being controlled depending on an adding amount of the p-type dopant. A purity of the Ga_2O_3 system single crystal is 6N.

Conventional methods of controlling the conductivity of a Ga_2O_3 system single crystal have been used to control resistivity of the Ga_2O_3 system single crystal when a conductive property is required. Conventional methods, however, possess several different drawbacks. It is difficult using conventional methods to widely control the resisitivity because a substrate or thin film made of the Ga_2O_3 system single crystal naturally tends to have an n-type conductive property. It is also difficult using conventional methods to make a substrate or thin film of the Ga_2O_3 system single crystal having a high insulating property despite the necessity of such a Ga_2O_3 system single crystal (Application at page 3, lines 8-21).

On the other hand, an exemplary aspect of the claimed invention includes a method of controlling a conductivity of a Ga_2O_3 system single crystal where a purity of the Ga_2O_3 system single crystal is 6N (Application at page 12, lines 14-17). This feature may provide a thin film or substrate with properties such as desired resistivity, controlled conductivity, and insulating properties (Application at page 6, line 13 to page 7, line 19).

II. THE PRIOR ART REJECTIONS

A. The Harwig Reference

Harwig discloses the temperature dependence of the electronic contribution to the conductivity of doped Ga_2O_3 single crystals (Harwig at page 205). The Examiner alleges that Harwig anticipates the invention of claims 16-18, makes obvious the invention of claims 19-21, and teaches features of claims 1, 4, 5, 8.

However, Harwig clearly fails to teach or suggest a method of controlling a conductivity of a Ga_2O_3 system single crystal "*wherein a purity of said Ga_2O_3 system single crystal is 6N*", as recited, for example, in claim 16 (Application at page 12, lines 14-17). This feature may provide a thin film or substrate with properties such as desired resistivity, controlled conductivity, and insulating properties (Application at page 6, line 13 to page 7, line 19).

The Examiner alleges that Harwig teaches a method for controlling a conductivity of a Ga_2O_3 system single crystal.

According to Harwig (page 205 at "2. Experimental"; lines 1-5 and page 206, lines 9-12), a purity of β-Ga_2O_3 powder is 4N. This is lower than in the claimed invention, where a purity of 6N is used.

Therefore, Applicant respectfully requests the Examiner to reconsider and withdraw the rejection.

B. The Ueda Reference

To make up for the deficiencies of Harwig, the Examiner applies Ueda. Ueda discloses the doping of a β-Ga_2O_3 single crystal with Sn (Ueda at Abstract). The Examiner alleges that Ueda modifies Harwig to make the invention of claims 1, 4, and 5 obvious.

However, like Harwig, Ueda clearly fails to teach or suggest a method of controlling a conductivity of a Ga_2O_3 system single crystal "*wherein a purity of said Ga_2O_3 system single crystal is 6N*", as recited, for example, in claim 1 (Application at page 12, lines 14-17).

According to Ueda on page 3561 (lines 6-8), a purity of β-Ga_2O_3 powder is 4N. This is lower than in the claimed invention, where a purity of 6N is used.

Thus, even assuming (arguendo) Harwig and Ueda would be combined by one of ordinary skill in the art, the resultant combination fails to teach or suggest that the conductivity of a Ga_2O_3 system single crystal is controlled by the adding amount of the dopant.

Therefore, Applicant respectfully requests the Examiner to reconsider and withdraw this rejection.

C. The Ichinose Reference

To make up for the deficiencies of Harwig, the Examiner applies Ichinose. Ichinose discloses a light emitting element (Ichinose at Abstract). The Examiner alleges that Ichinose modifies Harwig to make obvious the invention of claim 8.

However, like Harwig, Ichinose clearly fails to teach or suggest a method of controlling a conductivity of a Ga_2O_3 system single crystal including "*wherein a purity of said Ga_2O_3 system single crystal is 6N*", as recited, for example, in claim 1 (Application at page 12, lines 14-17).

The Examiner alleges that Ichinose teaches "adding the p-type dopant such as zinc (Zn) to Ga_2O_3 single crystal. However, Ichinose clearly fails to teach or suggest a Ga_2O_3 single crystal having a purity of 6N.

Therefore, Applicant respectfully requests the Examiner to reconsider and withdraw this rejection.

III. NEW CLAIMS

New claims 22-27 have been added to claim additional features of the invention and to provide more varied protection for the claimed invention. These claims are independently patentable because of the novel and nonobvious features recited therein. Specifically, none of the prior art reference teach or suggest a method of controlling a conductivity of a Ga_2O_3 system single crystal "*wherein said desired conductivity is dependent upon an amount of said predetermined dopant added to said Ga_2O_3 system single crystal*", as recited, for example, in claim 22 (Application at page 6, lines 4-12).

According to Harwig (page 206, lines 4-9), "only a few hundred parts per million of Zr or Mg had actually been incorporated." In Harwig, there is no disclosure in which a conductivity is controlled depending on an adding amount of a dopant. Thus, a conductivity of β-Ga_2O_3 system single crystal might be affected by impurities of the β-Ga_2O_3 powders that exist in Harwig.

In addition, Harwig at page 206 and in Figure 1 only shows a temperature dependency of the conductivity of β-Ga_2O_3 system single crystal. Thus, Harwig does not teach or suggest that the conductivity of a Ga_2O_3 system single crystal is controlled by the adding amount of the dopant.

In addition, according to Ueda on page 3562, at Figure 1, the conductivity of Ga_2O_3 is controlled by changing the growth atmosphere, which is clearly contrary to the claimed invention. Also, only one conductivity of Sn-doped Ga_2O_3 is shown by Ueda. Thus, Ueda clearly fails to teach or suggest that the conductivity of a Ga_2O_3 system single crystal is controlled by the adding amount of the dopant.

Like Harwig, Ichinose also teaches a temperature dependency of the conductivity of β-Ga_2O_3 system single crystal. Thus, Harwig does not teach or suggest that the conductivity of a Ga_2O_3 system single crystal is controlled by the adding amount of the dopant.

Applicant submits that the new claims are patentable over the cited prior art references at least for analogous reasons to those set forth above.

IV. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 1, 4, 5, 8, and 14-27, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

Date: October 20, 2008

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